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THE RELATION OF MICROTECHNIQUE TO THE MORPHOLOGY OF SOME PROTOZOAN PARASITES[1]

By Professor D. H. WENRICH

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To a considerable extent the diagnosis of parasitic protozoa, and certainly the study of their detailed morphology, is dependent upon the application of technical processes of fixing and staining and the necessary accessory procedures. The taxonomy of many protozoan parasites is based upon morphological characters determined by a study of fixed and stained specimens. The diagnosis of intestinal protozoa is greatly aided by resorting to properly prepared fixed and stained slides, and in the experience of my associates and myself in making protozoological surveys, both the number of positives and the accuracy of their recognition are greatly enhanced by the study of permanent slides. The tendency to conduct surveys without the use of such preparations is to be deplored.

The following presentation will be largely concerned with intestinal protozoa, to which I have devoted considerable attention for more than twenty years. More especially the intestinal amoebae of man will be considered. During these years several thousand slides have been made and examined; over 130 different chemical substances or different dilutions or combinations of them have been tried out as fixing agents; but not so much has been attempted with different

[1] Condensed with slight revision from the presidential address delivered before the American Society of Parasitologists, December 31, 1940. The complete article with illustrations is published in the *Journal of Parasitology*, 27: 1, February, 1941.

stains. It is inappropriate and impractical to do more than refer to some of the more important results obtained.

In connection with these studies I am indebted to many sources and many individuals for assistance. For financial assistance I am indebted to the Special Research Fund of the University of Pennsylvania, the Penrose Fund of the American Philosophical Society and a special research fund contributed by John Wyeth and Brother of Philadelphia. For technical assistance at various times my thanks are due to Dr. Q. M. Geiman, Dr. R. M. Stabler and especially to Dr. Sarah H. Stabler. For help in securing source material I am indebted to many individuals, but more especially to Drs. A. D. Waltz, R. M. Stabler, John H. Arnett, H. A. Shelanski, J. H. Clark, A. L. Luchi and M. M. Rothman and Mr. R. L. Brown.

Before taking up the results of the study of particular species of parasites, I wish to make some comments on certain technical processes.

My experiments show that time is a relatively unimportant factor in the fixing process for these parasites. Fixation of smears of intestinal protozoa for one minute with the fixing agents commonly employed gives results as good as or better than those obtained by fixation for longer periods of time.

Heidenhain's iron alum hematoxylin is probably the best and the most commonly used stain for the smaller intestinal protozoa. Larger kinds, such as many of the ciliates and gregarines, do not stain so well with this stain unless they are sectioned. For these larger animals destaining with a saturated aqueous solution of picric acid will often give more satisfactory results than destaining with iron alum. This method[2] may be used to advantage for intestinal amoebae but does not do so well for flagellates. The Heidenhain method as described in many books requires a number of hours to carry through. However, as recommended by Craig and Faust,[3] if the mordant and stain are heated to 35 or 40 degrees C., the time in each can be cut to two to five minutes and results secured which can be used in diagnosis.

Mayer's hemalum is a quick and useful stain but does not stain cytoplasmic structures well and hence is not so appropriate for flagellates. It may also fail to stain the endosomes of species of *Entamoeba*. It has the advantage of being rapid and of staining all parts of a smear with approximately equal intensity. With proper precautions in interpretation, it becomes a useful diagnostic stain.

Feulgen's nucleal reaction is a valuable technique for recognizing certain details of nuclear structure, but results with its use are sometimes disconcerting. For example, it has often been surprising to find that a standard Feulgen procedure which produces typical coloring of nuclear chromatin in metazoan nuclei, may show a weak coloring or none at all in the nuclei of protozoa on the same slides. Nuclei at one stage in the life history of a protozoan may show the proper color reaction, while those of some other stage do not. On smears of the seminal vesicle of earthworms containing monocystid gregarines, the nuclei of trophozoites appeared to have no color reaction, while nuclei of the spores were well stained. Specimens of *Cryptobia* (*Trypanoplasma*) from fresh-water fishes showed only a faint reaction in the nucleus, while the kinetoplast (parabasal) was intensely colored. As pointed out by Margolena[4] and others, various plant materials containing aldehydes, such as lignin, etc., may give a positive Feulgen reaction. It is obvious, therefore, that nuclear chromatin does not always give a positive Feulgen reaction, and not everything that stains by this method is necessarily chromatin.

In metazoan nuclei the chromatic reticulum usually colors by the Feulgen method, while the nucleoli do not. There are cases, like some of the large oocytes, when even the reticulum does not show a typical reaction. Failure of nuclei to show this reaction may be due to the finely divided state of the reacting material. For staining reactions in general, the dispersion factor is important. If a stainable material is divided into fine granules and scattered amongst non-staining substances, the stain, if any, in these small particles, may be overlooked or masked by the associated substances. As a matter of fact, a close re-examination of the nuclei of the trophozoites of the gregarines referred to above revealed that there were fine granules of Feulgen reacting material in the reticulum of these nuclei, although absent in the endosomes (nucleoli). When this material is condensed to form chromosomes at the time of nuclear division, the coloring is much more readily recognizable as Meglitsch[5] noted for *Endamoeba blattae*. The Feulgen method is an important technical procedure, but here, as always, interpretation needs to be made with due caution.

A few results of experiments with different fixing agents will be referred to. One of the methods of experiment has been to study the effects of the constituents separately and then put them together again in different ways. This has been done for some of the commonly used fixing solutions. Various dilutions of mercuric chloride, alcohol, acetic acid, picric acid, chromic acid, etc., have been tried and approximately one hundred new combinations of them—with various other substances added—have been tested. None of

[2] H. C. Tuan, *Stain Tech.*, 5: 135–138, 1930.
[3] "Clinical Parasitology," Lea and Febiger, Philadelphia, 1937.
[4] *Stain Tech.*, 7: 9–16, 1932.
[5] *Jour. Parasitol.*, 25: 441–442, 1939.

these new combinations has appeared to have any great superiority over those in common use.

A study of the effects of different concentrations of some of these commonly used ingredients showed that weaker solutions, such as 25 per cent. to 50 per cent. of saturated mercuric chloride; 1 per cent. to 5 per cent. acetic acid or 50 per cent. alcohol are more satisfactory fixing agents for intestinal protozoa than stronger concentrations. It was shown by Dr. Geiman and myself[6] that one-half-strength Schaudinn's fluid is a satisfactory fixing agent for these organisms, and I have further found that even one-fourth-strength does very well for the same species. It is suggested that new fixing solutions which are much weaker and therefore more economical than those commonly employed may well be devised.

Schaudinn's sublimate alcohol, with a little acetic acid added, is probably more commonly used as a fixing agent for intestinal protozoa than any other single fixative. This is desirable, since it is a great advantage to have different workers use some one method so that comparison of results will be more valid. However, this fixing solution does not always give the same results, as explained beyond, and it is not the best fixative for many of the larger protozoa, such as the larger ciliates and gregarines, since it causes too much shrinkage and distortion. It is always advisable to try a number of methods with each different species to be investigated, in order that more worth-while results may be obtained.

As might be expected, many protozoa present different appearances when treated with different techniques. However, the same technique does not always produce the same result with the same species of parasite, because of the variability of the organisms themselves or of the environments in which they are found; and the different species often give different results with the same technique because of inherent specific differences. It is obvious, therefore, that a number of techniques needs to be employed to secure anything like a full picture of the morphology of any one species, and a single method is usually not applicable to any considerable number of species.

To show the effects of certain reagents and to illustrate the application of the general statements made above, it will be convenient to refer to a few particular species of protozoan parasites.

Various workers have shown that the parabasal body of trichomonad flagellates does not ordinarily stain with iron hematoxylin when the flagellates are fixed with Schaudinn's fluid with a small amount of acetic acid added, but does stain when they are fixed with Flemming's fluid or other chrom-osmic combinations. Grassé[7] and his associates have stated that acetic acid is especially destructive of the parabasal body in these organisms. Kirby[8] has shown that even though the parabasal will not stain with Heidenhain's after Schaudinn's fluid plus acetic, it will stain with Delafield's hematoxylin.

When *Trichomonas muris* is fixed in Schaudinn's plus 5 per cent. of acetic and then some of the slides stained with Heidenhain's and some with Delafield's, the difference in appearance of the flagellates is very striking. After Heidenhain's the parabasal body fails to stain but all the other organelles, including the large number of cytoplasmic granules, usually stain intensely. After Delafield's the parabasal stains but the cytoplasmic granules are stainless and practically invisible. Since such granules are considered diagnostic for certain species, the differences here might readily be misinterpreted if they were not known to be the result of different stains. That acetic acid does not destroy the parabasal body of *T. muris* is shown by the fact that this structure will stain with Delafield's even when the flagellates are fixed in 20 per cent. acetic acid used alone. When such smears are treated with Heidenhain's none of the cytoplasmic organelles stain.

Cysts of *Girardia lamblia,* from the small intestine of man, tend to show a remarkably constant staining reaction with iron hematoxylin when a variety of fixing agents are employed, although the amount of shrinkage within the cyst membrane may vary considerably. The endosomes of the nuclei and the various parts of the fibrillar apparatus commonly show an intense coloration with this stain. There are some interesting exceptions, however. In one case fixation with chrom-acetic with a little copper oxide added produced practically no shrinkage inside the cyst wall but none of the cell structures was stained. Phosphotungstic acid hematoxylin was found to stain the peripheral layer of the nucleus in *Giardia* cysts when Heidenhain's seldom does, and this feature of nuclear organization is commonly overlooked. While the staining reactions within the cysts of *Giardia* are usually fairly uniform, sometimes they are surprisingly variable. Even on the same slide one may find variations from practically no stain to strong staining of organelles. Such individual variations are difficult to explain in terms of variation in the environment.

Since the genera of endozoic amoebae are differentiated to a large extent by the differences in their nuclear structure, the effects of different reagents on these nuclei were studied.

Attention had previously been called to the fact that higher percentages of acetic acid added to Schaudinn's fluid tended to reduce the stainability of the endosome in the nuclei of the cysts of *Iodamoeba*

[6] *Stain Tech.*, 8: 158, 1933.

[7] *Arch. Zool. Exper. et Gen.*, 65: 345–602, 1926.

[8] *Tr. Am. Micr. Soc.*, 50: 189–195, 1931.

bütschlii.[9] There is much variation in these reactions, but when various strengths of acetic acid were used alone as fixing agents, 20 per cent. or higher caused the nucleus to lose its stainability in iron hematoxylin. When one half of a saturated solution of mercuric chloride was used as a fixing agent, the nuclei in *Iodamoeba* tended to stain homogeneously with Heidenhain's, but with hemalum the entire nucleus stained lightly except a small granule in the endosome. It is possible that this granule represents a centriole.

For *Endolimax nana* Stabler[10] showed that when the content of acetic acid in Schaudinn's fluid was increased to 15 or 20 per cent., the endosome of the nucleus stained less readily with iron hematoxylin. This result seems to be characteristic for this species but there are many variations. One sometimes finds nuclei with unstained endosomes even when no acetic has been added to the Schaudinn's fluid used as the fixative, and when 20 per cent. of acetic is added, one may find that stainability of the endosomes has been retained by some of the nuclei. Acetic acid used alone as a fixing agent may reduce the subsequent stainability of the endosomes even in concentrations as low as 2 per cent. and when 20 per cent. is used alone the nuclei fail to stain. In combination with other substances the effect of acetic acid varies. Adding 5 per cent. to saturated mercuric chloride solution increases the stainability of the endosome, but when the same strength is added to one-half saturated solution, the stainability of the endosome is decreased. Adding 5 per cent. of acetic to 50 per cent. alcohol decreases the stainability of the endosome, but does not do so when added to 95 per cent. alcohol. It would seem that the stronger reagents prevent the action of the acetic toward diminishing the stainability of the endosome. These experiments were carried out on the trophic stages.

Segal[11] has called attention to the fact that "buds" were produced on the cysts of *Endolimax nana* more frequently when they were fixed in picromercuric than when fixed with Schaudinn's and several other fixatives. She also noted that different races of this species had different tendencies in regard to the formation of "buds." The present study has confirmed the work of Segal and has shown further that "buds" can be produced by 25 to 50 per cent. acetic acid.

Both hemalum and phosphotungstic acid hematoxylin, after most fixatives used, had a greater affinity for the peripheral layer of the nucleus of *E. nana* than did iron hematoxylin.

Dientamoeba fragilis in its reaction to technical agents shows many contrasts to the other amoebae living in man. It is usually necessary to add from 10 to 20 per cent. of acetic acid to Schaudinn's fluid to get the nuclei to stain with Heidenhain's. But there are interesting exceptions. In some cases, when nuclei failed to stain after Schaudinn's plus 5 per cent. of acetic, they stained very well when the same material was fixed in one-half-strength of the same fixing solution. In certain cases stainability of the nuclei was greater when only 2 per cent. of acetic was added to Schaudinn's than when 5 per cent. was added, as it was also when 20 per cent. was added. In some other cases, the nuclei have stained readily after Schaudinn's without any acetic added. In one such case the feces were strongly acid to litmus so that it is supposed that organic acids in feces would affect the stainability of the nuclei upon fixation in sublimate alcohol. It is obvious, therefore, that the environmental conditions may markedly affect the results of such technical processes.

Experiments show that acetic acid will increase the stainability of the nuclei of this species when added to mercuric chloride, alcohol and other single substances. When used alone in any strength from 2 to 100 per cent., the nuclei of *Dientamoeba* are rendered stainable with iron hematoxylin. Bouin's fluid is an excellent fixative and hemalum an excellent stain for this species.

Entamoeba histolytica shares with *Endolimax nana* and *Iodamoeba bütschlii* the tendency for the endosome of the nucleus to lose stainability with Heidenhain's when increasing strength of acetic acid are added to Schaudinn's fixing solution. The stainability of the endosome may be lost when 5 per cent. acetic is used alone, and when 20 per cent. is used the entire nucleus remains unstained. When 50 per cent. is used as the fixative, some stainability may remain in the peripheral layer of the nucleus. After 50 per cent. acetic a wide shrinkage space appeared between the cytoplasm of cysts and the cyst membrane, or else extensive extrusions of cytoplasm were produced. These relatively enormous "buds" lacked a definite boundary at their outer surfaces, in contrast to "buds" produced by other agents. Fixation with Bouin's fluid may cause shrinkage spaces to appear either inside or just outside the nucleus of trophic stages, or, in some cases, may cause the endosome to fail to stain with iron hematoxylin. Alcoholic Bouin's may produce "buds" on the cysts of *E. histolytica.*

The cysts of *Entamoeba coli* often show much more variation in stainability than other species when fixed with Schaudinn's fluid and stained with Heidenhain's. Hemalum stains these cysts much more uniformly. Higher percentages of acetic acid added to Schaudinn's fluid have less tendency to diminish the stainability of the nuclei than in the case of *E. histolytica.* When 50 to 100 per cent. of acetic acid is used alone as a fixa-

[9] D. H. Wenrich, *Proc. Am. Phil. Soc.*, 77: 183–205, 1937.
[10] *Jour. Parasitol.*, 18: 278–281, 1932.
[11] *Am. Jour. Hyg.*, 15: 741–750, 1932.

tive, there usually appear in the cysts of *E. coli* extensive shrinkage areas between the cytoplasm and the cyst membrane or there may be large extrusions or "buds," as in *E. histolytica*. These "buds" appear to have been produced explosively and lack a definite boundary at the outer periphery.

That different species of intestinal amoebae show divergent reactions to the same technique has been indicated in the preceding accounts. These differences probably represent chemical peculiarities in the composition of the nuclei of these several taxonomic categories. Such differences were revealed by fixing the five species of amoebae found in the intestine of man with the same fixing agent, namely, Schaudinn's fluid plus 5 per cent. of acetic acid, and then staining them by three different methods: Heidenhain's hematoxylin, Mayer's hemalum and the Feulgen reaction. If our attention is confined to the nuclei it may be noted that the picture that has been considered characteristic for each species is given by the Heidenhain's stain. For *Entamoeba histolytica* and *E. coli* the endosome and peripheral layer stain well and a certain amount of periendosomal material also. This periendosomal material is usually more voluminous in *E. coli*. For *Iodamoeba bütschlii* there is no peripheral layer but the endosome and periendosomal layer stain deeply. For *Endolimax nana* the endosome stains deeply but the peripheral layer does not stain so well. With *Dientamoeba fragilis* no peripheral layer is seen, but the central nuclear mass stains well.

With hemalum the peripheral and periendosomal layers of *E. coli* and *E. histolytica* stain well, but the endosome tends to remain unstained, especially in *E. histolytica*. In *Iodamoeba* the endosome tends to stain more lightly than the peripheral layer, especially in the cysts, while in *Endolimax* both the endosome and the peripheral layer stain well. In *Dientamoeba* the stain is about the same as with Heidenhain's.

After Feulgen's technique only the periendosomal material of *E. histolytica* and *E. coli* show a coloration which is weak, but usually more pronounced for *E. coli*. In *Iodamoeba* only the periendosomal layer stains but the reaction is strong. In *Endolimax* only the peripheral layer stains but the reaction is weak. In *Dientamoeba* the reacting material is apparently identical to that which stains with Heidenhain's and hemalum. These evidences of chemical differences in the constitution of the nuclei of different kinds of intestinal amoebae offer important confirmation to the validity of the taxonomic groupings that have been established.

It may be well to repeat that different techniques may produce decidedly divergent appearances in the same species of parasite; on the other hand, there may be much variation in the appearances of various races or strains or individuals of the same species when treated with the same technique due to peculiarities of the organisms themselves or to differences in the environment at the time of fixation; various species give divergent reactions to the same technique because of inherent differences in their chemical constitution.

SCIENTIFIC EVENTS

MEDICAL FELLOWSHIPS OF THE NATIONAL RESEARCH COUNCIL

FOURTEEN fellowships in the medical sciences, including four renewals, were awarded at the recent meeting of the Medical Fellowship Board of the National Research Council, Washington, D. C., of which Dr. Francis G. Blake, Sterling professor of medicine at Yale University, is the chairman. A list of the successful candidates and institutions where they are to work follows:

Reginald M. Archibald (renewal), Hospital of the Rockefeller Institute.
Lindsay E. Beaton (renewal), Northwestern University.
Lauritz R. Christensen, New York University.
Albert H. Coons (renewal), Harvard Medical School.
William J. Darby, Jr., Columbia University.
J. Russell Elkinton (renewal), Yale University.
Frank L. Engel, Yale University.
Nathan B. Friedman, Yale University.
Robert Hodes, University of Pennsylvania.
Max N. Huffman, Columbia University.
Joseph L. Irvin, Columbia University.
Harry Lusk, University of Michigan.
Maclyn McCarty, Hospital of the Rockefeller Institute.
Francis D. Moore, Harvard Medical School.
Richard J. Porter, Harvard Medical School.
Douglas S. Riggs, Yale University.
Richard B. Singer, Harvard Medical School.
Stewart G. Wolf, Cornell University Medical College.

In addition to the above, in the new series of fellowships announced last fall for work in the filtrable viruses and orthopedic surgery, made possible through a grant from the National Foundation for Infantile Paralysis, Inc., seven fellowships were awarded, as follows:

Seymour S. Cohen, Rockefeller Institute for Medical Research, Princeton.
Charles E. Evans, University of Rochester.
Robert H. Green, Hospital of the Rockefeller Institute.
Walter P. Havens, Jr., Hospital of the Rockefeller Institute.
Joseph L. Melnick, Yale University.
Eleanora Molloy, Columbia University.
Addison B. Scoville, Vanderbilt University.

THE INDUSTRIAL RESEARCH INSTITUTE

THE third annual meeting of the Industrial Research Institute was held in Pittsburgh on May 16 and 17. More than fifty research executives from leading industrial concerns attended the meeting, which had headquarters at the Hotel Schenley. H. Earl Hoover, vice-president of the Hoover Company, Chicago, gave the address of the retiring chairman. Problems of industrial research management and of the education and training of research personnel were discussed at informal round table sessions during the meeting. There were group visits by the members and guests of this organization of research directors to the research laboratories of the Aluminum Company of America, Gulf Research and Development Company, Jones and Laughlin Steel Corporation, the Mellon Institute, the United States Bureau of Mines and the Westinghouse Electric and Manufacturing Company.

The Industrial Research Institute, an affiliate of the National Research Council, was organized three years ago to provide an agency for the study of research organization and management in industry, rather than technical problems. The membership is composed of industrial concerns maintaining research laboratories as a part of their organization. The chief executives in charge of research of the member companies represent them in the activities of the institute. It has its headquarters in Chicago.

At a dinner session, Donald R. G. Cowan, manager of commercial research of the Republic Steel Corporation, Cleveland, addressed the institute on the "Relation between Market and Technical Research."

The main technical sessions of the meeting were devoted to round table discussions. The important question of how the training of men for industrial research can be improved, both in our college and universities and after employment in industry, were discussed on the Friday round table. On Saturday morning, the members of the institute compared their respective methods of scheduling and controlling the many technical research projects that make up a laboratory's "production line" of daily work.

New officers and directors were chosen at a business meeting. L. W. Wallace, director of engineering and research, Crane Co., Chicago, was elected chairman, and F. W. Blair, chemical director, the Procter and Gamble Company, Ivorydale, Ohio, was elected vice-chairman, for the ensuing year. H. S. Benson, of the Research Division, United Shoe Machinery Corporation, Beverly, Mass., and W. R. Hainsworth, vice-president of Servel, Inc., New York, were also elected to three-year terms on the executive committee. Other members of the committee are: H. Earl Hoover, vice-president, The Hoover Company, Chicago, past chairman; Caryl P. Haskins, president, Haskins Laboratories, New York; Maurice Holland, director, Division of Engineering and Industrial Research, National Research Council, New York, and R. C. Newton, chief chemist, Swift and Company, Chicago.

CONFERENCE ON THE SUN AND SOLAR-TERRESTRIAL RELATIONSHIPS AT THE HARVARD OBSERVATORY

TWENTY-TWO investigators in the fields of astronomy, physics, meteorology and biology took part in a "Conference on the Sun and Solar-Terrestrial Relationships" at the Harvard Observatory on June 2 and 3. Recent studies of the sun and the solar atmosphere, the effect of solar radiation on the upper atmosphere of the earth and the influence of the sun on the earth were discussed. The conference was designed to review scientific work in progress on solor problems, and to discuss plans for future research.

Among the specific problems considered were the spectrum of the solar corona, new methods of measuring solar energy, sun-spots, effects of the sun on radio reception, relation of the sun to earth magnetism, photosynthesis, relation between radiation and growth of plants and variations in solar radiation. Dr. Robert R. McMath, of the McMath-Hulbert Observatory of the University of Michigan, showed his unusual motion pictures of motion in the solar prominences. A principal topic of the discussions was the recent discovery of the Swedish physicist, Dr. Bengt Edlén, that hitherto unidentified elements in the solar spectrum are probably iron, nickel and calcium in high stages of atomic excitation.

The participants in the conference included Professor Henry N. Russell, director of the observatory of Princeton University; Professor Brian O'Brien, of the observatory of the University of Rochester; Dr. Alvin G. McNish, of the Carnegie Institution of Washington; Dr. McMath, of the University of Michigan; Dr. Charles G. Abbot, secretary of the Smithsonian Institution, Washington, D. C., and Dr. Harlan T. Stetson, Professor Manuel S. Vallarta, Dr. C. L. Pekeris and Dr. Henry H. Hemmendinger, of the Massachusetts Institute of Technology.

Members of the faculty of Harvard University who took part were Professor Harlow Shapley, Professor Donald H. Menzel, Dr. Leo Goldberg, William Petrie, Dr. Fred L. Whipple, Karl F. Guthe, Miss Pearl Rubenstein and Dr. Cecilia Payne Gaposchkin, all of the Harvard Observatory; Associate Professor Harry R. Mimno and John A. Pierce, of the Cruft Laboratory of Communication Engineering; Professor Kenneth V. Thimann and Dr. F. K. Skoog, of the Harvard Biological Laboratories, and Mrs. H. F. Cullinane, of the Blue Hill Meteorological Observatory.

THE DEDICATION OF THE YALE MEDICAL LIBRARY

DEDICATION ceremonies for the Yale Medical Library will be held on Sunday, June 15, during the commencement exercises of the university. The building, which has accommodations for 400,000 volumes, is an extension of the Sterling Hall of Medicine. One wing is devoted to the general medical library and the other to the historical library. Each wing opens off a rotunda which is dedicated to the late Dr. Harvey Cushing, from 1912 to 1932 Moseley professor of surgery at Harvard University, and Sterling professor of neurology in the Yale School of Medicine from 1933 to 1937. Dr. Cushing left his entire medical library of 15,000 volumes, which includes 165 incunabula, to form a nucleus for the historical library. Other collections which have been deposited in the library are those of Dr. John F. Fulton, Sterling professor of physiology; Dr. Edward C. Streeter, of Stonington; Dr. George M. Smith, research associate in anatomy; Dr. Clements C. Fry, lecturer in psychiatry and mental hygiene; Dr. George Blumer, David P. Smith clinical professor of medicine, emeritus, and the late Sterling professor of physiology, Dr. J. G. Dusser de Barenne. The fifteenth century medical and scientific library of Dr. Arnold C. Klebs, of Nyon, Switzerland, will be added later.

Wilmarth S. Lewis, of Farmington, chairman of the Yale Corporation's Committee on the Library and Museums, will preside at the dedication exercises. Starling W. Childs, of Norfolk, of the class of 1891, will present the memorial gift for the class. President Charles Seymour will accept on behalf of the university and will present the keys of the building to Dean Francis G. Blake, of the School of Medicine. The principal address will be given by Dr. John Homans, of Boston.

SUMMER CONFERENCES AT STANFORD UNIVERSITY

NINE conferences are planned at Stanford University this summer, the first beginning immediately after commencement on June 15. These conferences have been arranged as scholarly observances of the fiftieth anniversary of the university.

The first conference, the fiftieth anniversary symposium, will be held from June 16 to 19, when leading American scholars will take part in a discussion of "The University and the Future of America." The speakers will include Ernest O. Lawrence, Aurelia H. Reinhardt, Isaiah Bowman, Roscoe Pound, Lewis Mumford, H. S. Jennings, Robert A. Millikan, Edwin P. Hubble, Walter B. Cannon, E. L. Thorndike, C. F. Kettering, Archibald MacLeish, William F. Ogburn, Edwin F. Gay and Herbert Hoover.

On Friday, June 20, coincident with the formal academic convocation and the dedication of the new Hoover Library on War, Revolution and Peace, members of the California Newspaper Publishers Association will open a three-day editors' conference.

From June 23 to 25 there will be a Conference on Higher Education, which will be sponsored jointly by Stanford University, the University of California, the University of Southern California, the Oregon System of Higher Education, the University of Washington, the California Institute of Technology and the American Council on Education. It is expected that those present will include George F. Zook, president of the American Council on Education; Frederick M. Hunter, chancellor of the Oregon State System of Higher Education; Homer P. Rainey, president of the University of Texas; Clarence Dykstra, president of the University of Wisconsin and chairman of the National Defense Mediation Board; President Russell M. Story, of Claremont Colleges; Dean C. B. Lipman, of the University of California; Karl W. Bigelow, American Council on Education; President R. B. von KleinSmid, University of Southern California, and President Ray Lyman Wilbur, Stanford University.

A Protein Research Conference will be held from June 24 to 27, at which the speakers will be Max Bergmann, C. L. Hoagland and L. G. Longsworth, of the Rockefeller Institute for Medical Research, New York City; E. J. Cohn, professor of biological chemistry, Harvard Medical School; M. A. Lauffer, Institute for Advanced Study, Princeton, N. J.; R. Schoenheimer, Columbia University; H. B. Vickery, Connecticut Agricultural Experiment Station; Vincent du Vigneaud, Cornell University Medical College.

From July 11 to 13 there will be a Conference on Taxation; from July 17 to 20 a conference for school teachers and administrators of the Pacific Coast on Education and the National Emergency; from July 21 to 25, the Stanford Business Conference for business and industrial executives of the Pacific Coast will be held; from July 13 to 18, a Conference on Physiotherapy, and on August 11 and 12, there will be mathematical conferences.

DEATHS AND MEMORIALS

DR. GEORGE EDWARD STONE, professor of botany at Massachusetts State College, Amherst, from 1893 to 1917, died on May 28 at the age of eighty years.

ARTHUR WILLIAM BERRESFORD, electrical engineer, who was a former vice-president and general manager of the Cutler-Hammer Manufacturing Company, died on May 20 at the age of sixty-eight years. Mr. Berresford had served as president of the American Institute of Electrical Engineers and of the American Engineering Council.

DR. JOHN ROSSLYN EARP, medical editor for the New York State Department of Public Health at Albany, died on May 19 in his fiftieth year.

DR. PRESCOTT LECKY, lecturer in psychology in the Extension Division of Columbia University, died on May 30. He was forty-eight years of age.

DR. C. G. CULLIS, professor of mining geology at the Royal School of Mines, Imperial College of Science and Technology, South Kensington, died on April 28.

THE *Journal* of the American Medical Association states that a painting by Dean Cornwell, the third in the series "Pioneers of American Medicine," was unveiled during special ceremonies in the Hotel Statler, Cleveland, on June 2. The painting shows Major Walter Reed and Dr. Carlos Finlay with Major General Leonard Wood, Dr. Jesse W. Lazear, Dr. James Carroll and Dr. Aristides Agramonte, and John R. Kissinger, the first volunteer soldier to be inoculated in the second set of yellow fever experiments. Miss Blossom Reed, daughter of Major Walter Reed, unveiled the painting. Mr. Cornwell chose the yellow fever subject at this time because of its significance in connection with national defense, since the Panama Canal would have been impossible without the success of Finlay and Reed. The series of paintings, depicting outstanding personalities and events in the history of American medicine, will take between ten and fifteen years to complete, one painting being done a year. Finished paintings are lent to medical schools and medical societies. The first two were "Beaumont and St. Martin" and "Osler at Old Blockley."

SCIENTIFIC NOTES AND NEWS

THE University of California conferred on May 24 the degree of doctor of laws on Dr. Willis Linn Jepson, professor of botany in the university. In awarding the degree the following citation was made by President Robert G. Sproul: "Willis Linn Jepson, native Californian, life-long resident of our state and graduate of this university in the class of 1889; zealous conservator of the priceless forest resources of the Pacific Coast and of the beauties of desert, valley and mountain; foremost authority on western seed plants and author of monumental works on California flora; tutored in the school of unremitting intellectual effort, you stand as an exemplar of the virtues inherent in rigorous discipline."

DR. PEYTON ROUS, member of the Rockefeller Institute for Medical Research, New York, has been elected an honorary fellow by the Royal Society of Medicine of London. As announced in SCIENCE on May 16, the Walker Prize for Cancer Research of the Royal College of Surgeons of England, was recently awarded to Dr. Rous.

RANSOM ELI OLDS, of Lansing, automotive engineer, and W. W. Croze, of Duluth, mining engineer, will receive the honorary degree of doctor of engineering at the fifty-fifth annual graduation exercises of the Michigan College of Mining and Technology. Mr. Olds will be presented for the degree by Professor R. R. Seeber, head of the department of mechanical engineering, and Mr. Croze by Dr. James Fisher, dean of the faculty.

DR. WILLIAM NEWTON HODGKIN, an alumnus of the School of Dentistry of the Medical College of Virginia, Richmond, a member of the Council on Dental Education of the American Dental Association, will be awarded the honorary degree of doctor of science at the commencement exercises of the college.

THE University of Manitoba has conferred the degree of doctor of laws on Dr. Otto Maass, MacDonald professor of chemistry and head of the department at McGill University, director of the Pulp and Paper Research Institute.

DR. HENRY FIELD SMYTH, who has been teaching since 1912 in the Department of Public Health in the School of Medicine of the University of Pennsylvania, an authority on industrial health, on the occasion of his retirement from active teaching, was given on May 24 a testimonial dinner at the Hotel Philadelphian by his friends and former students.

DR. JOHN H. J. UPHAM, professor of pathology and director of the College of Medicine of the Ohio State University, will be the guest of honor on June 6 at a testimonial dinner given by the faculty on the occasion of his retirement.

THE Casselberry Prize, consisting of a plaque and $100, of the American Laryngological Association, given for original investigation in laryngology and rhinology, has been awarded to Dr. Noah Daniel Fabricant, of the University of Illinois, for his work on head colds and sinus conditions.

PROFESSOR CLAUDIUS LEE, of the department of electrical engineering of the Virginia Polytechnic Institute, at a meeting in Roanoke on May 10 of the Virginia Section of the American Institute of Electrical Engineers, was presented with a certificate of merit in recognition of his forty-eight years of service to the institute and to the state.

THE Leslie Dana Gold Medal, awarded annually by the St. Louis Society for the Blind, "for outstanding achievements in the prevention of blindness and the conservation of vision," will be presented this year to Dr. Arnold H. Knapp, a director of the Knapp Foun-

dation in Ophthalmology at Columbia University and editor-in-chief of the Archives.

THE Meyer Medal of the American Genetic Association was presented on June 2 at the Plant Introduction Station at Glendale, Md., of the U. S. Department of Agriculture, to Dr. Edmundo Navarro de Andrade, of Brazil. The medal was awarded in recognition of "distinguished services to plant introduction," especially for the successful introduction into Brazil of the eucalyptus tree, where it now grows extensively and is of great commercial value.

DR. GUSTAV ERNST FREDERICK LUNDELL, chief chemist of the Division of Chemistry of the National Bureau of Standards, has been nominated for president of the Society for Testing Materials. Dean Harvey, of the Engineering Laboratories and Standards Department of the Westinghouse Electric and Manufacturing Company at East Pittsburgh, Pa., has been nominated for vice-president.

DR. ELIOT D. CHAPPLE was elected on May 2 president of the Society for Applied Anthropology, an organization formed at the opening of a two-day conference at Harvard University. The society includes in its membership psychologists, sociologists, economists and others who will apply the results of their research to benefit industry, to social work and to other phases of human relations.

THE American Federation for Clinical Research was organized at Atlantic City on May 5 by the election of the following officers: *President,* Maurice A. Schnitker, Toledo, Ohio; *Vice-president,* Arthur J. Merrill, Atlanta, Ga.; *Secretary-Treasurer,* Thomas M. Durant, Philadelphia; *Councillors,* J. Allen Kennedy, Nashville; Charles H. Wheeler, Jr., New York; Richard H. Lyons, Eloise, Mich; Eugene L. Lozner, Boston. The meeting next year will be held in St. Paul. Richard L. Varco, Minneapolis, was elected chairman of the Program Committee for 1942.

DR. IRVING S. CUTTER, professor of internal medicine and dean of the Medical School of Northwestern University, will retire on September 1 with the title of professor of medicine emeritus and dean emeritus. Dr. James R. Miller, associate professor of medicine, has been appointed dean.

DR. KARL BUEHLER and Dr. Charlotte Buehler, formerly of the University of Vienna, have been appointed visiting professors in psychology at Clark University for the first semester of the coming academic year. Dr. Karl Buehler will give three courses in the field of genetic psychology and Dr. Charlotte Buehler will offer instruction in clinical child psychology. During their semester of residence at Clark special plans will be made for psychologists to visit the laboratories and hold conferences.

PROFESSOR FRANK O. ELLENWOOD, head of the department of heat-power engineering in the Sibley School of Mechanical Engineering of Cornell University, has been appointed John E. Sweet professor of mechanical engineering.

DR. KENNETH KNIGHT LANDES, professor of geology and chairman of the department at the University of Kansas and assistant state geologist, has been appointed professor of geology and chairman of the department at the University of Michigan, to take office on the retirement of Professor Ermine C. Case, who will reach the age of seventy years in September.

DR. THOMAS HARRIS OSGOOD, since 1934 head of the department of physics at the University of Toledo, has been appointed professor of physics and head of the department at the Michigan State College. He succeeds Professor Charles W. Chapman, who retires on September 1.

DR. A. F. WOODS, director of the Graduate School of the U. S. Department of Agriculture for the last fifteen years, will retire on July 1, and will become director emeritus and part-time educational adviser. He will be succeeded by Dr. Eldon L. Johnson, administrator of the school and formerly a teacher of courses in administrative management.

DR. ERVAL R. COFFEY, assistant chief of the domestic quarantine division of the U. S. Public Health Service, has been appointed assistant surgeon general. He will be chief of the Division of Sanitary Reports and Statistics and will direct the public relations of the Health Service.

DR. KARL T. COMPTON, president of the Massachusetts Institute of Technology, has been elected a member of the advisory council of the National Broadcasting Company. The council, of which Owen D. Young is chairman, was established fourteen years ago for guidance on matters of public policy.

DR. ALEŠ HRDLIČKA, of the U. S. National Museum, delivered the second annual Todd Memorial Lecture of the Daniel Smith Lamb Anthropological Society on May 29 at the Medical School of Howard University. He spoke on "The Advent and Antiquity of Man in the Western Hemisphere." The annual Todd Memorial Lecture is given in honor of Dr. Wingate Todd, of Western Reserve University. The Daniel Smith Lamb Anthropological Society was founded two years ago to perpetuate the memory of Dr. Lamb, a former professor of anatomy at Howard University.

DR. WILLARD Z. PARK, head of the department of anthropology at the University of Oklahoma, will spend the summer in research in northern Colombia. A grant by the American Philosophical Society of Philadelphia has made this work possible.

DR. GEORGE D. LOUDERBACK, dean of letters and science and senior professor of geology at the University of California, delivered a series of lectures on geology and engineering at the Agricultural and Mechanical College of Texas from May 7 to 11. This was the second series of lectures to be sponsored by the department of geology, which plans to make the lectures an annual event. Dr. Louderback discussed in detail the applications of geology to engineering. One popular lecture of the series was devoted to the landscapes, people and geological features of Western China. On May 11 a field trip was made to the Marquez Salt Dome under the direction of Dr. H. B. Stenzel.

THE forty-ninth annual meeting of the Society for the Promotion of Engineering Education, which will be held at the University of Michigan from June 23. to 27, will give special attention to a discussion of science and technology in engineering courses. More than 2,000 engineering teachers from leading educational institutions are expected to attend. Included among the speakers are Dr. Alexander G. Ruthven, president of the University of Michigan; Dr. D. B. Prentice, president of Rose Polytechnic Institute and president of the society; R. A. Seaton, director of engineering defense training for the U. S. Office of Education; James W. Parker, vice-president and chief engineer of the Detroit Edison Company; Dean A. A. Potter, of the Purdue University College of Engineering, and Professor R. A. Dodge, of the College of Engineering of the University of Michigan.

THE First Latin American Congress of Plastic Surgery will be held in Rio de Janeiro and São Paulo from July 6 to 12, under the sponsorship of the Latin American Society of Plastic Surgery. Dr. Antonio Prudente is president of the congress.

TWO alumni members, nine members and seven associates were initiated by the Lehigh University Chapter of the Society of the Sigma Xi at the annual initiation and banquet on May 21. The retiring president, Dr. Clarence A. Shook, associate professor of mathematics, introduced Dr. Edgar T. Wherry, associate professor of botany at the University of Pennsylvania, who spoke on "Camera Studies of Western Wild Flowers." The officers elected for the ensuing year are Dr. Bradford Willard, professor of geology, *president;* Cyril D. Jensen, associate professor of civil engineering, *vice-president;* Dr. W. L. Jenkins, assistant professor of psychology, *secretary,* and Francis J. Trembley, assistant professor of biology, *treasurer.*

THE *Bulletin* of the American Society for Testing Materials states that the Office of Production Management has announced the formation of a committee appointed by the National Academy of Sciences and the National Research Council to advise the office on technical matters relating to metals and minerals. This committee is known as the Advisory Committee on Metals and Minerals. It is made up of the following four groups: Ferrous Minerals and Ferroalloys Group, Metals Conservation and Substitution Group, Tin Smelting and Reclamation Group, Nonmetallic Minerals Group. This committee will take over the activities of the various separate technical committees that heretofore have been advising the National Defense Advisory Commission and the Office of Production Management. Clyde E. Williams, director of the Battelle Memorial Institute, Columbus, Ohio, is chairman of the committee; Dr. Gilbert E. Seil, technical director, E. J. Lavino Company, Norristown, Pa., is chairman of the Ferrous Minerals and Ferroalloys Group; Zay Jeffries, technical director, Incandescent Lamp Department, General Electric Company, Cleveland, is chairman of the Metals Conservation and Substitution Group; and F. W. Willard, president, Nassau Smelting and Refining Company, Inc., New York, N. Y., is chairman of the Tin Smelting and Reclamation Group. The Nonmetallic Minerals Group is in process of formation.

THE cornerstone of the new addition to the Roosevelt Hospital, New York City, to be erected at the cost of $1,000,000, was laid on May 21, in the absence of Mayor La Guardia, by Dr. Willard C. Rappleye, commissioner of hospitals. The addition replaces a sixty-eight-year-old building recently demolished, and is joined to the ward section of the main hospital. The new unit is to be five stories in height, and will contain seven new operating rooms, in addition to other hospital facilities.

THE National Foundation for Infantile Paralysis has given $30,000 to the University of Michigan for the establishment of a laboratory for the study of virus diseases. It will be conducted within the new School of Hygiene and Public Health soon to be built with funds donated by the Rockefeller and the W. K. Kellogg Foundations. The laboratory will be set up in the University Hospital and later transferred to the Public Health Building.

DURING the first four weeks of the summer session of 1941 (June 30–July 24) a seminar on the fat-soluble vitamins will be conducted at the University of Michigan. Guest speakers will include A. C. Curtis, University of Michigan; Edward A. Doisy, St. Louis University; Harry N. Holmes, Oberlin College; Fred C. Koch, University of Chicago, and Henry A. Mattill, University of Iowa. The chemistry and physiology of vitamins A, D, E and K will be discussed.

Further information may be obtained from Professor Howard B. Lewis, Department of Biological Chemistry, Medical School, University of Michigan, Ann Arbor.

FIVE tuition-free courses in higher mathematics, open to graduate students and approved by the United States Office of Education, will be offered in the evenings beginning on June 12 in the New York University College of Engineering at University Heights. The program will include advanced methods of applied mathematics, fluid dynamics and applications, theory of elastic plates, electrical network theory and a seminar on vibrations. Applications may be made to the college, Room 204, Bliss Building, University Heights. Applicants must have a bachelor of science degree and several years of graduate instruction in mathematics or physics. The tuition and expenses of the courses will be paid by the Office of Education from a congressional grant of $9,000,000 for engineering defense courses.

DISCUSSION

NUTRITIONAL PROBLEMS OF NATIONAL DEFENSE

AT the recent symposium conducted by the Chicago Branch of the American Association of Scientific Workers, a group of scientists gathered from all over the country heard three eminent authorities in the field of nutrition describe the pressing nutritional problems of our national defense and a method of meeting them. At the meeting, held the evening before the convening of the Federation of American Societies for Experimental Biology, Dr. Hazel Stiebeling, senior food economist of he U. S. Department of Agriculture, disclosed that, according to the latest figures available, fully 50 per cent. of the nation's children are being raised on inadequate food allotments. That this weakness must inevitably be felt in any attempt to forge a strong defense for this nation, and that its correction could not be prosecuted too strongly, were vigorously emphasized by Dr. Stiebeling. She clearly pointed out that the workers and soldiers of to-day had been brought up among just such conditions and that those who will replace them—the youth of to-day—must have improved nutritional conditions to be maximally effective in the work to be done. Dr. Stiebeling showed how improvement in economic status and purchasing power is a prime requisite which, in part, is being met by the government's surplus commodities and food stamp program. However, it was stressed that this must be coupled with a far-reaching educational program to influence best nutritional utilization of each dollar spent. "We need," said Dr. Stiebeling in summary, "immediate action on a broad front by many agencies if nutrition is to play its necessary part in national defense."

Colonel Paul E. Howe, of the Sanitary Corps, outlined the set-up by which the army is now being fed, and he emphasized the improvement that modern attitudes have wrought in the army diet. Allotment of a certain amount of money for food per day is not enough, and now for the first time the army is required specifically to prepare a ration that is nutritionally balanced.

Dr. Russell Wilder, of the Mayo Clinic, gave the third talk, "Nutrition in the United States—A Plan for the Future," in which he emphasized again the need for nutritional adequacy. He cited specific results of research at the Mayo Clinic, revealing drastic personality degeneration and working inefficiency which were caused by B_1 deficiency and which became increasingly difficult to clear up as the duration of deficiency was prolonged. He mentioned the susceptibility of large populations to great pandemics when nutrition is impaired, as in the last war, and he specifically cited the large loss of sight among Danish children when the Danish butter, and with it the vitamin A supply, was exported to Germany. Dr. Wilder stated that particularly in the last sixty years, because of the use of milled white flour and purified white sugar, the diet of the average American has been in a worse nutritional state than at any time previously. He stated that for success in national defense "the time element is of extreme importance—as much in human values as in mechanical ones." Because education is of necessity such a slow process, requiring a time lapse before results appear, Dr. Wilder based his plan for the immediate nutritional future of America on three major and feasible procedures. First, he proposed that the wheat milling processes be modified to include the greatest possible vitamin content. (This, as a result of his committee's suggestion, is actually already being carried out.) Secondly he proposed that to all refined sugar there be added 20 per cent. of its weight of skimmed milk solids—an excellent and relatively cheap source of needed vitamins and minerals. Third, he suggested that the only remaining deficiency should be overcome by supplying vitamin C as citrus fruit or concentrates thereof.

In these three talks we have, for what we believe the first time, been given a clear picture of just what the nutritional needs of the country are; and, in addition, we have been given a method of action to meet these needs within a finite time and by workable means.

ALBERT M. POTTS

CHICAGO

BIOLOGICAL PUBLICATION IN AMERICA

A SURVEY of biological publication in America has recently been completed by the Committee on Research Publications of the Division of Biology and Agriculture of the National Research Council. Questionnaires were sent to managing editors of 65 biological journals; replies were received from 54. Information was sought concerning editorial management, editorial policy, promptness of publication of papers, number of words per page, cost per page, economic status, etc.

Editors of journals are selected in a variety of ways. Many are appointed by societies controlling journals, several by the Wistar Institute. Some editorial boards were originally self-constituted and are now self-perpetuating. Occasionally, ownership of a journal determines who should edit it. Tenure on an editorial board varies from 1 year to life.

In response to the question as to whether or not editorial boards in judging manuscripts sought advice from outside authorities, all but 3 or 4 of the managing editors agreed that they did ask such advice, although many stated that they did so only occasionally or even rarely. Twenty-five journals do not have any specified limit to the length of the papers, other journals have limits of from 4 to 50 pages. As a matter of fact, some of the journals which theoretically accept papers of any length actually publish only short papers. Some journals set no limit on the number of illustrations, some require that the illustrations do not exceed 20 to 25 per cent. of the total space and some allow 2 plates. Authors are not usually required to contribute to the cost of publication, but are often asked to pay for excess illustrations, for special illustration or for excess tabular material. Some journals do not provide authors with free reprints; some may give as many as 100. The average number of free reprints is approximately 32.

Some editors frankly do not print papers in order of receipt, others claim they follow priority "as a rule," "to some extent," "generally," etc. In some cases, if a paper is written by a member of the society sponsoring the journal, it receives priority. In other journals, if the publication of a paper is paid for, it receives precedence. Papers requiring revision are delayed in some journals and priority of publication may be determined by order of acceptance.

The number of words published per page by different journals varies from 250 to 800; the cost per page from a low of $2.00 to a high of $9–$10. There is an increasing tendency to publish more words per page, and various members of the committee have helped to encourage editors to practice economy in this way.

Journals now appear to publish more promptly than they were able to do some years ago. Our survey showed only two journals in which the interval of time between receipt of an article and its publication was as much as 12 months. The average interval was 3.3 months.

One of the most important points brought out by the survey is the fact that many journals are now receiving more manuscripts than they can publish. Approximately 63 per cent. of the editors questioned stated that they were forced to reject manuscripts suitable for publication. This is a serious situation, for it imposes a severe limit on publication. If worthy papers are to remain unpublished, this undoubtedly will not only prevent the dissemination of knowledge, but will also discourage research activity on the part of those who are unable to publish the results of their investigations.

In facing this problem, the committee at its last meeting decided first that increased publication could be obtained if various journals practiced greater economy. In a number of instances, due in part to the effort of the committee, editors have been persuaded to change the form of their journals in such a way as to print many more words per unit of cost. Changes of this sort have undoubtedly speeded up publication and have cut down the percentage of rejections. The committee would like to print a handbook for editors in order to guide them on questions of type and arrangement, illustrations, specifications for printers, etc. Preparation of such a handbook would require funds, which at present are not available.

Even if the strictest economy were practiced, it is doubtful if our biological journals could publish the results of all the valuable research now in progress in this country. In the past, many American workers published papers in foreign journals. The war has largely put an end to this practice. Moreover, the war has also cut down subscriptions from abroad and has thus reduced the income of our journals. With much of the world at war, it is extremely important for America to serve as a haven for biological research. But this research is fruitless if it fails of publication. What is sorely needed is a subsidy fund for American biological journals. The Committee on Research Publications has asked its chairman to attempt to raise money in order to provide a handbook for editors and also to give support for those journals which, in spite of rigid economy, are unable to satisfy the publication needs in their respective fields.

Finally, there is another aspect of the problem concerning which the committee has very little data and no basis for discussion. Obviously, if editors reject many worthy papers submitted to them, it must be difficult to avoid discrimination. Clearly, it is important that a reasonable degree of impartiality be shown. Undue discrimination might cause genuine harm to the progress of biological science in America.

The Committee on Research Publications of the Division of Biology and Agriculture of the National

Research Council is eager to improve the status of biological publication in America. Any suggestions which would help it in its work would be sincerely appreciated. These should be sent to the Chairman, L. V. Heilbrunn, Zoology Department, University of Pennsylvania, Philadelphia, Pa.

L. V. HEILBRUNN

UNIVERSITY OF PENNSYLVANIA

THE WISTAR INSTITUTE—AMERICAN FILM CENTER MOTION PICTURE SURVEY

IN recent years the number of motion pictures in medicine and allied subjects has increased enormously. With this increase, however, has come a growing confusion throughout the whole field. Doctors wishing to arrange film programs have been at a loss where to go for information about pictures to fill their needs. The present-day catalogues are full of titles concerning the standard techniques in medicine and surgery, but generally there are no descriptions of the films. Each catalogue also fails in being a complete list on any one topic, because it attempts to include too many and random subjects. Thus the doctor has no means of discriminating between the various films listed.

It is a fact that scientific films are being used in teaching more each year, but that excellent ones are often buried in the mass of mediocre material that no advantage is derived from their existence. Appreciating this, The Wistar Institute of Anatomy and Biology, in collaboration with The American Film Center, made a survey of the pictures in its field. In addition, The Wistar Institute hoped to establish a library of the best productions and research films where they could be catalogued and made available for use. A questionnaire was sent accordingly in February, 1940, to members of The American Society of Zoologists and The American Society of Anatomists asking for information on motion pictures in colleges and medical schools.

The questionnaire was designed to cover three topics: the extent to which medical and biological films are now used, the sources of these films (or the details of their production where they were made on the spot), and whether copies would be made available for filing in The Wistar Institute Library. The results showed an overwhelming interest in the use of teaching pictures. Out of 638 replies, 432 men indicated that films were shown in their classes, and 25 others said there were plans for doing so once the facilities were available.

One hundred and sixteen out of the number using films had made their own, while the remainder had bought, borrowed or rented them, in about equal proportions. Where outside sources were called upon, there were listed the names of 57 different educational and non-commercial institutions, and 32 commercial groups, including drug-houses, insurance companies, etc. In considering production, the association's members had chosen 16mm film over 35mm by a ratio of 6:1, and one third of those undertaken were in color. While a small number of films were made for lay audiences, the majority were technical, and intended for students as well as other scientific groups. Quite naturally only a few were sound films.

With regard to submitting prints to a central library for filing and distribution there were varied and rather inconclusive answers, although 67 were favorable to such a plan. Distribution and financing problems must be solved before a general acceptance of the scheme will be possible.

The actual value of this survey lies, however, in the use which will be made of its findings. A file is now available, with copies in The Wistar Institute and The American Film Center, of the moving pictures actually used by anatomists and biologists throughout the country, with brief descriptions of the content in most cases. Likewise there is now a list of the sources of the greater number of these films. The Wistar Institute has already set up its reviewing service, whereby critiques of those films passed and reviewed by carefully chosen boards, representing the American Association of Anatomists, the American Society of Zoologists and the Wistar Institute, are printed in its journals. Slowly a library of the best research and teaching pictures is being collected, and distribution plans are to be worked out.

EDMOND J. FARRIS
DONALD SLESINGER

THE WISTAR INSTITUTE,
PHILADELPHIA, PA.

INDUSTRIAL SOLVENTS AS POSSIBLE ETIOLOGIC AGENTS IN MYELOID METAPLASIA[1]

THERE has recently been described under the name of agnogenic myeloid metaplasia a syndrome which both from a clinical and hematologic point of view has been frequently confused with myelogenous leukemia, hemolytic jaundice or anemia.[2]

The term agnogenic implies that the etiology of the condition was then unknown. A comparison of the histologic findings in this condition with those found in chronic benzol poisoning[3] together with certain

[1] From the Collis P. Huntington Memorial Hospital, Mallory Institute of Pathology, Thorndike Memorial Laboratory, Second and Fourth Medical Services (Harvard), Boston City Hospital, and the Department of Medicine, Harvard Medical School, Boston.

[2] Henry Jackson, Jr., Frederic Parker, Jr., and Henry M. Lemon, *New England Jour. Med.*, 222: 985–994, 1940.

[3] Tracy B. Mallory, Edward A. Gall and William J. Brickley, *Jour. Indust. Hyg. and Toxicol.*, 21: 355–392, 1939.

clinical evidence led to an investigation of the occupational histories of the patients now in our clinic with myeloid metaplasia.

All the 6 available for study gave a history of exposure to certain industrial solvents including benzol and carbon tetrachloride. Case 1 worked for 5 years with benzol in a shoe factory. Case 2 cleaned mesh machines with benzol for half an hour a week for 16 years. Case 3 washed bearings in "high test gasoline" for 20 minutes 4 times a day for 26 years. Case 4 was exposed to the fumes of carbon tetrachloride for an hour each day for 8 years. Case 5 used large amounts of paint remover for 1½ hours a day for 15 years. Case 6 was exposed to a paint remover containing benzol intermittently for a period of many years.

These facts suggest that exposure in some individuals to certain fat solvents may result in the clinical picture previously described as agnogenic myeloid metaplasia. It is quite likely that some patients with this syndrome will give no history of such an exposure, and it is reasonably certain that many so exposed will escape unscathed.

Further work on this subject is being carried out.

RULON RAWSON
FREDERIC PARKER, JR.
HENRY JACKSON, JR.

THE OPOSSUM, *DIDELPHIS VIRGINIANA* KERR, A NEW HOST FOR PARAGONIMUS IN TENNESSEE

IN the early fall, 1940, Mr. Malcolm V. Parker, a graduate student at Northwestern University, forwarded the writer a box of twelve mounted and a vial of eight preserved specimens of a lung fluke he had removed from the lungs of a single opossum, *Didelphis virginiana* Kerr, while in residence at the Reelfoot Lake Biological Station in Tennessee during the summer. The host was taken by Mr. John B. Calhoun, another graduate student at Northwestern University, while working on the food habits and distribution of mammals in the vicinity of Reelfoot Lake. Although several specimens of the opossum had been taken during the summer, not more than six of these hosts had been searched for their parasites. The writer spent six weeks at the station, but had opportunity to examine only three of the opossum hosts from the region. Only the single host harbored the lung fluke.

The fluke has been identified tentatively as *Paragonimus westermani* (Kerbert, 1878). Recognizing the uncertainty of the taxonomy of the members of the genus *Paragonimus,* the anatomy of the present form has been worked out in considerable details, and the writer is of the opinion that but one species exists. In so far as is known the opossum has not been reported heretofore as a host of *Paragonimus,* although, as pointed out by Hall,[1] much work has been done on this fluke by Japanese workers and it is just possible that the opossum host has been included. However, there is some evidence to indicate that the American opossum is refractive to an infection with this fluke. Ameel[2] found no infection in 109 of this host from an endemic area in Michigan and failed to produce an infection when the opossum was fed large numbers of viable cysts of *Paragonimus.* No infection has been found in over thirty opossums autopsied in Georgia.

ELON E. BYRD
UNIVERSITY OF GEORGIA

SCIENTIFIC BOOKS

CAMPBELL ON THE EVOLUTION OF THE LAND PLANTS

The Evolution of the Land Plants (Embryophyta). By DOUGLAS HOUGHTON CAMPBELL. 731 pp., 351 figs. Stanford University Press. 1940. $6.50.

THE book before us scarcely measures up to its title, "The Evolution of the Land Plants," or the promises of its Introduction. What it really turns out to be is a very valuable summary of the present state of knowledge of development from Bryophytes to Angiosperms. That this is extremely well done goes without saying to any one who knows anything of Campbell's own original work, especially on the Bryophytes. One looks in vain, however, for an equally comprehensive discussion of the various hypotheses of origins and relationships that have been put forward. The author is obviously aware of these, but there are no reasons given for his acceptance of one or rejection of another. When one has led such a long and fruitful life, as has the author, and has been so close to the firing line of his science, his friends and colleagues and those of the younger generation of botanists who come under his influence naturally expect, whether they have a right or not to such an expectation, that out of his experience and wisdom he will state why he *e.g.* accepts Wettstein's system and rejects that of Parkin and Arber regarding the evolution of the flowering plants.

That this is not merely carping criticism is, I think, shown by the feeling of approval which the reviewer would accord to Campbell's judgment in the cases mentioned. The book itself consists of twenty-seven chapters of which four are devoted to Bryophytes, eight to the Pteridophytes, as they are called in the text, but

[1] *Jour. Parasitol.,* 11: 227–228, 1925.
[2] *Am. Jour. Hyg.,* 19: 279–317, 1934.

not in the chapter headings, four to the Gymnosperms, and five to the Angiosperms. The remaining chapters are devoted to an Introduction and discussions of the Gametophyte, the Sporophyte, the First Vascular Plants, and Heterospory and the Seed Habit.

As might be expected the first section of the book, that devoted to the Bryophytes, is in my judgment, the best, even though one seems to be turning the pages of Campbell's classic "Mosses and Ferns." The chapters on the vascular plants do not seem so fresh or based on first-hand information.

Campbell follows Engler in dividing the plant kingdom into two main divisions—Thallophyta and Embryophyta, which is quite as justifiable as dividing animals into Vertebrates and Invertebrates. He considers the Thallophyta as highly unscientific, which of course it is, but says there is abundant reason for Embryophyta, this being in the main the essential similarity in the reproduction of what he calls Bryophytes, Pteridophytes and Spermatophytes. Campbell believes that land plants were derived from some freshwater green alga, perhaps some form like Coleochaete among the Ulothricales.

He attaches great importance to the fact that the spermatozoids are biciliate in bryophytes and lycopods and polyciliate in the remaining pteridophytes, but doesn't go as far as Lotsy did in formally classifying the extinct Paleozoic groups on this basis. He regards Pteridosperms as an order rather than a class or phylum, and as representing the most advanced Filicinae or the most primitive gymnosperms.

The section of the book devoted to vascular plants may well be considered to mark the end of a morphological era which began with Hofmeister, of which it may be said that although it inspired a truly prodigious amount of investigation and publication, the garnered crop hardly fulfils the expectations of the cultivators. It seems to me that plant morphology has always been greatly handicapped by the fact that it was formulated almost wholly on the living flora at a time when ideas of phylogeny scarcely entered the minds of taxonomists, and when the concept of the flower was a mystical thing compounded of design in Nature and a pentateuchal cosmogony. These concepts were, in the main, those of morphological entities as fixed as the pieces of a jigsaw puzzle and almost wholly divorced from function (conduction, support, photosynthesis, etc.). These fixed morphological units, as rigid as the pre-Linnean concept of taxonomic species, were then carried back into the more primitive plant world of an enormous past. In other words, morphological units based upon the living flora might better be considered to have a phylogeny as well as an ontogeny and to be end products of an evolution just as truly as the so-called species of the systematist. This may have been envisaged in the author's frequent use of the word Homoplasy, but judging by the results this seems to be merely lip service to the idea.

Pilger's conclusion regarding the nature of the cone in the coniferales is a good illustration of my contention of the importance of function. Incidentally if, as contended, the ovular scale of the Pinaceae, epimatium of the Podocarpaceae are adaptations for the protection and nutrition of the ovules it follows that the Araucariaceae are more ancient than the Pinaceae. Campbell seems to consider a relationship between Araucariaceae and what he calls the Paleozoic Lycopodineae, but he is very cautious, and states the conflicting views without coming to a conclusion. What, other than tradition, can countenance our maintenance of Monocot and Dicot as the two classes of flowering plants, or calling the Caytoniales of the Jurassic Angiosperms, or considering the Devonian Psilophytales as Pteridophyta, or even the acceptance of the notion that the Filicales are of equal rank with Equisetales and Lycopodiales. With regard to the possible ancestors of the Angiosperms both the Gnetales and Bennettitales are discarded and Campbell, following Engler, favors a purely hypothetical group of protangiosperms.

As I hinted at earlier: When morphology shall have become wedded to function or adaptation, morphologists will be free of worry about telomes, caulomes, phyllomes, rhizomes and trichomes; we need no longer puzzle over whether the alternation of generations is antithetic or homologous, and, I believe, it will be a better world.

I can well imagine that the present work would be a wonderful text for advanced classes in comparative morphology since it is clear, inclusive, eminently scholarly and critical. That the book contributes anything beyond this to the evidence of the evolution and classification of plants is more doubtful.

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VETERINARY BACTERIOLOGY

Veterinary Bacteriology. By I. A. MERCHANT, D.V.M., Ph.D., C.P.H., associate professor of veterinary bacteriology and hygiene, Iowa State College. pp. 628. Ames, Iowa: The Iowa State College Press. Postpaid, $7.00.

THIS is a text-book written for students of veterinary medicine, but any who desire to have up-to-date descriptions of the principal organisms which affect the domestic animals will find the book useful and reliable. The writing is lucid, the arrangement is logical and systematic, and the subject-matter shows that the author has combed the literature recently and well. The publication date was in October, 1940, yet

the book contains many references to papers published in 1940. For a first edition there are remarkably few errors, typographical or otherwise. The author has called to his aid several collaborators; A. G. Karlson to write the chapter on the genus *Erysipelothrix,* C. T. Rosenbusch on the *Pasteurella,* S. H. McNutt on the *Brucella,* and L. H. Schwarte on "Filterable Viruses and Virus Diseases." With only a few exceptions, the illustrations were taken from that excellent collection of photomicrographs of bacteria contained in Nowak's "Documenta Microbiologica."

The arrangement of the chapters is not unusual. After two parts devoted to general biology of microorganisms and principles of immunity which together make up twelve chapters, the remaining 28 chapters are devoted to descriptions of the organisms and viruses which are pathogenic for animals. The pathogenic protozoa have been omitted on the assumption that protozoa, in the veterinary curriculum, will be considered in the course in parasitology rather than in bacteriology. This is not the case, in some institutions at least, and the reviewer feels the book is incomplete in this respect.

The author has done his best work in the portions of the book devoted to the description of organisms. These are clearly and systematically presented, and a short list of references is given for each section so the more ambitious student may read more widely if he desires. The portion relating to general biology is rather elementary, but the chapter on disinfection is better than is usually found in such text-books.

Students of veterinary medicine need a strong grounding in the bacteriology of milk and milk products, since many of them find themselves rather intricately involved in problems surrounding milk production and handling after graduation, and, for this reason, the reviewer misses a section devoted to this subject. In the crowded curriculum of veterinary schools to-day, there seldom is any opportunity for students to obtain much work in the bacteriology of milk, except in the course in pathogenic bacteriology. A chapter on this subject would, in the opinion of the reviewer, serve a much better purpose than the one on "Bacteriological Technics and Methods," which will be skipped by most teachers who are giving a laboratory course along with the lectures because it is inadequate as a laboratory guide and superfluous when one is used.

No two teachers have ever agreed on the exact content of any course or on how a course can best be given. Whereas the reviewer differs from the author in some respects on what he has selected and what he has left out of his book; nevertheless, it is his opinion that this text is well written, accurate and, of the group of shorter dissertations useful as student texts and brief reference, the best that we have in its field.

W. A. HAGAN

CORNELL UNIVERSITY

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

A PROPOSED REVISION OF THE CONSTITUTION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FROM the time of its formation in 1848, the American Association for the Advancement of Science has been a democratic organization, directed and managed by a representative body under a published set of statements and rules.[1] The original "Objects and Rules of the Association" were amended and became its first constitution in 1851. A partial revision occurred in 1856 and some "constitutional troubles" were "finally disposed of" through the adoption of a new constitution in 1874, when the association was incorporated under the laws of the Commonwealth of Massachusetts. With occasional amendments to care for continual advance and improvement through experience, the constitution of 1874 remained in force for 46 years. Before 1887, the "standing committee" of the association controlled association affairs; through an amendment adopted in that year, the standing committee became the council, which has been the governing body since that time. By 1917 the constitution of 1874 had been rendered somewhat unsatisfactory because of the remarkable development of the association and its increasing activities. A special committee on constitution revision, consisting of J. McKeen Cattell (*chairman*), Herman L. Fairchild and Daniel T. MacDougal, began its studies in that year; on its recommendation the present constitution was adopted at the third St. Louis meeting two years later. With a few minor amendments, that constitution has been in force since January 3, 1920.

On December 30, 1939, feeling that a new revision of constitution and by-laws had again become desir-

[1] Much information on the history and development of the American Association may be found in the volumes of its Proceedings and Summarized Proceedings. Special reference should be made to Herman L. Fairchild's "History of the American Association for the Advancement of Science" (SCIENCE, 59: 365–369, 385–390, 410–415, 1924); to Austin H. Clark and Leila Forbes Clark's "Background and Origin of the American Association for the Advancement of Science" (Summarized Proc., 1929–1934: 15–30, 1934); and to F. R. Moulton's "Brief History of the Association" (Summarized Proc., 1934–40: 1–57, 1940).

able, the executive committee of the council appointed a special committee on constitution revision, consisting of B. E. Livingston (*chairman*), E. R. Long and F. R. Moulton. After prolonged study, with helpful criticism and suggestion from other members of the executive committee, the special committee presented a proposed new constitution on April 27, 1941. In accordance with action taken by the executive committee on that date, the proposed revision is now published for consideration by the members of the council and others. Suggestions for improvement are requested to be sent, before July 1, to Dr. F. R. Moulton, Permanent Secretary, A. A. A. S., Smithsonian Institution Building, Washington, D. C. The present constitution is reprinted here for comparison. All suggestions received will be duly considered by the special committee and the executive committee, and it is hoped that a final draft may be approved by the council and presented, as a proposed constitutional amendment, before a general session at the next annual meeting of the association, which will open on December 29, 1941, in Dallas, Texas. Article 11 of the present constitution provides that an amendment may be adopted by a unanimous vote at a general session or by a majority vote at two consecutive annual meetings.

The special committee has made a preliminary study of the present By-Laws and Rules of Procedure, which will naturally require revision when a new constitution becomes effective. Amendments to By-Laws and Rules may be adopted by vote of the council, without reference to a general session (By-Laws and Rules, Article XI), and a proposed revision of them is to be presented to the council at the Dallas meeting.

The proposed revision of the constitution and the constitution of 1920 follow:

BURTON E. LIVINGSTON
ESMOND R. LONG
FOREST R. MOULTON
Special Committee of the Executive Committee on the Revision of the Constitution of the Association

APRIL 27, 1941

PROPOSED REVISION OF THE CONSTITUTION

Published by order of the Executive Committee of the Council

ARTICLE I—OBJECTS

The object of the Association is to advance science, as by promoting intercourse and cooperation among those who are interested in science, contributing to a general understanding and appreciation of the methods and objects of science, holding scientific meetings, publishing scientific journals, monographs and books, providing aid for scientific research, making awards for meritorious scientific accomplishments, and cooperating with other scientific societies, institutions, and agencies.

ARTICLE II—MEMBERSHIP

Section 1. Any person, institution or organization desiring to support the objects of the Association may be elected to membership by the Council. The membership of the Association shall consist of members and fellows as follows: (a) annual members, (b) life members, (c) sustaining members, (d) honorary members, and (e) fellows.

Section 2. (a) *Annual members.* Annual members shall pay such annual dues as the Council shall determine.

(b) *Life members.* A person who pays to the Association at one time a life-membership fee of one hundred dollars may be elected a life member, exempt from the payment of dues. The Council may provide for the election of emeritus life members under such conditions as it shall determine. Life-membership fees shall be a part of the permanent funds of the Association.

(c) *Sustaining members.* A person who pays to the Association a sustaining-membership fee of one thousand dollars may be elected a sustaining member, exempt from the payment of dues. Sustaining-membership fees shall be a part of the permanent funds of the Association.

(d) *Honorary Members.* The Council may provide for the election of honorary members under such conditions as it shall determine.

(e) *Fellows.* A member who is professionally engaged in scientific work or has made a notable contribution to science may be elected by the Council to be a fellow. Election of a member as a fellow does not change his membership dues.

ARTICLE III—OFFICERS

Section 1. The officers of the Association shall consist of a President, a Vice President from each section who shall be Chairman of the Section, a Permanent Secretary, a General Secretary, a Treasurer, and a Secretary of each section, all of whom shall be elected by ballot from fellows of the Association by the Council at annual meetings of the Association. The term of office of the President and the Vice Presidents shall be one year; the term of office of other officers shall be four years. The officers shall perform the usual duties of their respective offices under the direction of the Council during their respective terms of office or until their successors shall have been elected.

Section 2. The Permanent Secretary, the Treasurer and such other officers as shall be designated by the Council shall be bonded at the expense of the Association for such amounts as the Council shall determine.

ARTICLE IV—COUNCIL

Section 1. The direction of the affairs of the Association, including the election of its officers, the control of its finances and publications, and the determination of its policies, shall be vested in the Council of the Association.

Section 2. The Council shall consist of (a) the President, the Vice Presidents, the Secretaries of the Sections,

the Permanent Secretary, the General Secretary, the Treasurer, the members of the Executive Committee, (b) one fellow elected by each Division of the Association, (c) one fellow elected by each affiliated Academy of Science, (d) two fellows elected by each affiliated society having more than 100 members who are fellows of the Association and one fellow elected by each affiliated society having not more than 100 members who are fellows of the Association, and (e) eight fellows, two elected each year by the Council for a term of four years. Twenty members of the Council shall constitute a quorum for the transaction of business.

Section 3. There shall be an Executive Committee of the Council which shall have power to act for the Council when the Council is not in session. The Executive Committee shall consist of twelve members: The President, the Retiring President, the Permanent Secretary, the General Secretary and eight fellows elected by the Council, two each year for a term of four years. A member of the Executive Committee shall not be eligible for reelection until one year shall have elapsed after he has served a full four-year term. A majority of the members of the Executive Committee shall constitute a quorum for the transaction of business.

Section 4. There shall be a Finance Committee consisting of the Permanent Secretary, the Treasurer and four other members elected by the Council, one each year for a term of four years, one of whom shall be elected by the Council as Chairman of the Finance Committee for the term of his office as a member of the Committee. The chairman shall be bonded at the expense of the Association for such amount as the Council shall determine. A majority of the Finance Committee shall constitute a quorum for the transaction of business.

ARTICLE V—SECTIONS

Section 1. The Association shall consist of the following sections: Mathematics (A), Physics (B), Chemistry (C), Astronomy (D), Geology and Geography (E), Zoological Sciences (F), Botanical Sciences (G), Anthropology (H), Psychology (I), Social and Economic Sciences (K), Historical and Philological Sciences (L), Engineering (M), Medical Sciences (N), Agriculture (O), Education (Q), and such other sections or subsections as the Council shall determine. Each member of the Association may designate the section or sections in which he wishes to be enrolled.

Section 2. Each Section shall have a Chairman who shall be elected by the Council on nomination by the Section Committee. Chairmen of the Sections shall be *ex officio* Vice Presidents of the Association. Each Section shall have a Secretary who shall be elected by the Council for a term of four years.

Section 3. Each section shall have a Section Committee consisting of (a) the Chairman and the Secretary of the Section; (b) four fellows of the Association, one elected each year by the Section for a term of four years; and (c) those Council representatives of affiliated societies and academies whose special fields lie in the general field of the Section.

Section 4. The Section Committee of each Section shall promote the objects of the Association in its own field; it shall prepare section programs for meetings of the Association either separately or in cooperation with other sections or societies; and, with the approval of the Council, it may organize an Executive Committee of the Section and other sub-committees.

ARTICLE VI—DIVISIONS AND BRANCHES

Section 1. Regional Divisions and Local Branches of the Association may be organized, by vote of the Council, for the purpose of promoting the objects of the Association in their respective territories.

Section 2. Each Regional Division or Local Branch shall elect its officers for such terms as it shall determine and shall hold meetings and conduct its affairs as it shall deem desirable, subject to the relevant provisions of this Constitution and of the By-Laws of the Association and to such special provisions as the Council of the Association shall establish.

ARTICLE VII—ASSOCIATED AND AFFILIATED SOCIETIES

Section 1. By vote of the Council a scientific society may be made an Associated Society or an Affiliated Society of the Association for the purpose of advancing more effectively the interests of science and of the society.

Section 2. Each affiliated society having not more than 100 members who are fellows of the Association and each affiliated academy shall be entitled to elect one fellow of the Association as its representative in the Council of the Association; each affiliated society having more than 100 members who are fellows of the Association shall be entitled to elect two fellows of the Association as its representatives in the Council of the Association. Associated societies shall not have representation in the Council of the Association.

ARTICLE VIII—MEETINGS

Section 1. The Association shall hold Annual Meetings at such times and places as the Council shall determine. Other meetings of the Association or of its sections may be held upon authorization by the Council.

ARTICLE IX—PUBLICATIONS

Section 1. Summarized Proceedings of the Association and directories of officers and members shall be published at such times and in such manner as the Council shall determine. By authorization of the Council the Association may publish journals, monographs and books.

ARTICLE X—FUNDS

Section 1. The Permanent Secretary shall collect the dues of members and other monies payable to the Association, except income on its permanent funds, and shall be custodian of these monies and shall make disbursements of them as the Council shall direct.

Section 2. The Treasurer shall be custodian of the permanent funds of the Association and other funds placed by the Council in his charge, under such conditions as the Council shall determine; shall collect income from

the funds in his charge and shall disburse monies as the Council shall direct; and shall administer bequests and gifts in accordance with the provisions of the donors. He shall sell such securities and properties of the Association, and he shall buy such securities and properties for the Association, with the permanent funds of the Association, as the Finance Committee shall direct by formal votes recorded in its minutes.

Section 3. The income from the membership fees of sustaining members and life members, while they are still living, may be appropriated by the Council for any purposes; after their deaths, the income from such funds shall be appropriated by the Council only for research.

ARTICLE XI—AMENDMENTS

Section 1. This Constitution may be amended at any general session of an annual meeting of the Association by a vote of nine-tenths of the members present, or by a majority vote of the members present at each of two general sessions held at consecutive annual meetings, provided that any proposed amendment shall have been published by the Association in its official journal not less than three months prior to its presentation for adoption.

THE PRESENT CONSTITUTION

In force since January 3, 1920*

ARTICLE 1—OBJECTS

The objects of the Association are to promote intercourse among those who are cultivating science in different parts of America, to cooperate with other scientific societies and institutions, to give a stronger and more general impulse and more systematic direction to scientific research, and to procure for the labors of scientific men increased facilities and a wider usefulness.

ARTICLE 2—MEMBERSHIP

Persons willing to cooperate in the work of the Association may be elected to be members by the Council. Members who are professionally engaged in scientific work or who have advanced science by research may be elected to be fellows. *The Council shall fix the admission fees and dues (Dec. 27, 1934).* A member who pays at one time the sum of one hundred dollars to the Association becomes a life member and is exempt from further dues. A person who gives one thousand dollars to the Association may be elected to be a sustaining member and is exempt from further dues.

ARTICLE 3—OFFICERS

The officers of the Association shall be elected by ballot by the Council, and shall consist of a President, a Vice President from each section, a Permanent Secretary, a General Secretary, a Treasurer and a Secretary of each Section. The President and the Vice Presidents shall be elected for one year, the other officers for four years. The officers shall perform the usual duties of these offices, under the direction of the Council.

* From Summarized Proceedings, 1934–40, pages 61, 62. Amendments adopted since 1920 are shown in italics, with dates of their adoption in parentheses.

ARTICLE 4—COUNCIL

The Council shall consist of the President, the Vice Presidents, the Permanent Secretary, the General Secretary, the Secretaries of the Sections, and the Treasurer, *the members of the Executive Committee, ex officio, if they are not otherwise members of the Council (Dec. 27, 1923)*, of one fellow elected by each *division, affiliated state academy, and (Dec. 27, 1932)* affiliated society, and one additional fellow from each affiliated society having more than 100 members who are fellows of the Association, and of eight fellows, two elected annually by the Council for a term of four years. There shall be an Executive Committee of the Council, consisting of the President, the Permanent Secretary, the General Secretary and eight members elected by the Council, two annually for a term of four years, who shall be *ex officio* members of the Council. The Council may appoint standing or temporary committees to make reports, to assist in the conduct of the work of the Association and to promote its objects.

ARTICLE 5—SECTIONS

The Association shall be divided into the following Sections: A, Mathematics; B, Physics; C, Chemistry; D, Astronomy; E, Geology and Geography; F, Zoological Sciences; G, Botanical Sciences; H, Anthropology; I, Psychology; K, Social and Economic Sciences; L, Historical and Philological Sciences; M, Engineering; N, Medical Sciences; O, Agriculture; P, *Industrial Science (Dec. 28, 1936)*; Q, Education. Members of the Association shall be members of that Section or of those Sections under which their work or their interests fall. Members of the Section shall nominate to the Council a Chairman, who becomes *ex officio* a Vice President of the Association and whose term of office shall be one year, and a Secretary, whose term of office shall be four years. These officers, together with four fellows, one elected annually by the Section for a term of four years, and the representatives on the Council of affiliated societies in the same field shall form a Sectional Committee. This Committee shall arrange the scientific programs of the meetings and may form sub-sections or hold joint meetings with other sections or other societies. It may appoint committees and shall in all ways promote the objects of the Association within its own field.

ARTICLE 6—DIVISIONS AND BRANCHES

Regional Divisions and Local Branches of the Association may be formed by vote of the Council. Such Divisions and Branches may elect officers, hold meetings, appoint committees, enter into relations with other societies and promote within their fields the objects of the Association.

ARTICLE 7—ASSOCIATED AND AFFILIATED SOCIETIES

National and local scientific societies may, by vote of the Council, become associated with the Association. Those Associated Societies which the Council shall designate as Affiliated Societies shall be represented on the Council and on the Sectional Committees as provided in Articles 4 and 5.

ARTICLE 8—MEETINGS

The Association shall hold an annual meeting at such time and place as may be determined by the Council. Other meetings of the Association and of the Sections may be authorized by the Council. The Divisions and the Branches may hold annual and other meetings.

ARTICLE 9—PROCEEDINGS

The proceedings of the Association and the list of officers and members shall be published in such manner as the Council may direct.

ARTICLE 10—FUNDS

The Permanent Secretary shall collect the annual dues and make expenditures as directed by the Council. The Treasurer shall deposit or invest the permanent funds of the Association, as provided for trust funds by the laws of the state of Massachusetts or the state of New York. Bequests and gifts will be administered in accordance with the provisions of the donors. The payments from sustaining and life members form part of the permanent fund, and the income (after the death of the member) shall be used for research, unless otherwise directed by unanimous vote of the Council or by a majority vote at two consecutive annual meetings.

ARTICLE 11—ALTERATION OF THE CONSTITUTION

This Constitution may be amended at a general session by unanimous vote or by a majority vote at two consecutive annual meetings.

SPECIAL ARTICLES

FETAL ENCEPHALOMYELITIS: PRENATAL INCEPTION OF INFANTILE TOXOPLASMOSIS[1]

HUMAN toxoplasmosis, first encountered as an encephalomyelitis in infants and verified by the experimental transmission of the infection to animals (Wolf, Cowen and Paige, 1939),[2, 3, 4] has since been found to produce an encephalitis in older children (Sabin, 1941),[5] and a predominantly pulmonary infection in adults (Pinkerton and Henderson, 1941),[6] the organism again having been successfully isolated in each instance. Although toxoplasmosis is known to be widespread among rodents and birds, the manner in which man acquires the infection has not yet been discovered. From the first, however, it had been felt that the infantile form of the disease was congenital.[3, 7, 8, 9, 10] The symptoms and signs began at birth or shortly thereafter. The chronic appearance of the pathological lesions, which were often extensively calcified, made it unlikely that they could have developed during the short extrauterine period. These findings suggested that the disease had begun as a fetal encephalomyelitis.[3, 7]

The considerations which weighed against this assumption were: (1) the mothers were all apparently healthy and some had had healthy children prior and subsequent to the birth of the infected child, (2) evidence of placental infection was lacking, and (3) evidence of the occurrence of adult human toxoplasmosis had not been furnished. The last objection is now overcome with the recent demonstration of adult toxoplasmosis.[6, 11] The first inconsistency, the fact that the mothers seemed healthy, may mean, as has been suggested elsewhere, that they harbored a latent infection. The common occurrence in lower animals of such clinically inapparent toxoplasmic infestation would lend support to such a possibility. Placentas have not, as yet, been available in these human cases, except in one instance in which the poor state of preservation made it unsatisfactory for study.

The suspicion that this infantile encephalomyelitis begins before birth is not original with the authors. Three cases[9, 10, 12] identified from the literature and reclassified as infantile toxoplasmic encephalomyelitis[3, 7, 8] were considered by the original authors to be instances of congenital disease, although proof was lacking.

Information acquired from additional cases coming to autopsy in this institution and further experimental data, which will be reported in detail elsewhere,[13] prove that infantile toxoplasmosis may begin as a fetal encephalomyelitis. One infant (B.R.) had given evidence of hydrocephalus *in utero*, necessitating cranioclasia for delivery. The child was born at term, was normally developed, except for the enlarged head, and was viable up to the time of delivery. The stillborn child on pathological examination presented an advanced toxoplasmic encephalomyelitis with extensive calcification of the lesions and an associated chorio-

[1] Supported in part by grants from Child Neurology Research (Friedsam Foundation) and the Matheson Commission.

[2] A. Wolf, D. Cowen and B. H. Paige, SCIENCE, 89: 226, 1939.

[3] *Idem, Am. Jour. Path.*, 15: 657, 1939.

[4] *Idem, Jour. Exp. Med.*, 71: 187, 1940.

[5] A. B. Sabin, *Jour. Am. Med. Assoc.*, 116: 301, 1941.

[6] H. Pinkerton and R. G. Henderson, *Jour. Am. Med. Assoc.*, 116: 807, 1941.

[7] A. Wolf and D. Cowen, *Bull. Neurol. Inst. N. Y.*, 6: 306, 1937.

[8] *Idem, Bull. Neurol. Inst. N. Y.*, 7: 266, 1938.

[9] J. Jankû, *Casopis lekarew ceskyck*, 62: 1021, 1923.

[10] C. M. Torres, *Compt. rend. Soc. Biol.*, 97: 1778, 1787, 1797, 1927.

[11] H. Pinkerton and D. Weinman, *Arch. Path.*, 30: 374, 1940.

[12] R. Richter, *Arch. Neurol. and Psychiat.*, 36: 1085, 1936.

[13] B. H. Paige, D. Cowen and A. Wolf. In preparation.

retinitis. Toxoplasmata were abundant in the lesions. In this instance, there can be no doubt that the infection was acquired during intrauterine life. Another infant (L.M.) came to autopsy recently with the typical lesions of toxoplasmic encephalomyelitis, which was verified by transmission of the infection to animals from postmortem material. An obstructive hydrocephalus, obviously due to the infection, noted two hours postpartum, points to the prenatal inception of the disease.

In an attempt to ascertain the existence of maternal infection, tests for neutralizing antibodies[14] in the blood of the mothers have been begun. The mothers of the above two infants with proven toxoplasmosis have been studied. Their sera, normal control sera and physiological saline solution were mixed with varying dilutions of mouse brain suspension infected with Toxoplasma, and inoculated intradermally into rabbits. The development of typical Toxoplasma skin lesions was used as an indicator. There was definite inhibition of the formation of such lesions by the sera of the mothers of the infected children. This demonstration of maternal neutralizing antibodies lends further support to the probability that infantile toxoplasmosis is of prenatal orrigin.

This disease of the central nervous system in infants has a specific pathological picture characterized by necrotizing chronic inflammatory lesions, miliary granulomata, conspicuous calcification, frequent hydrocephalus and focal chorioretinitis.[3, 7, 8] The absence of major developmental anomalies of the brain indicates that the infection, when congenital, probably begins late in fetal life.

The symptoms and signs of widespread cerebral damage, roentgenographic evidence of internal hydrocephalus and cerebral calcification, the ophthalmoscopic observation of a striking chorioretinitis, and the presence in the blood of neutralizing antibodies to Toxoplasma, have led to the clinical diagnosis of several new cases also to be reported later. Of these children, two (P.D. and A.I.) have survived to the ages of 4 and 2 years, each giving anamnestic evidence of the disease early in infancy. These children are mentally deficient, and one, subject to convulsions, had been regarded as an epileptic. It is quite probable that such instances of infantile toxoplasmic encephalomyelitis, which survive with severe cerebral damage, may be erroneously classified as congenital malformation of the brain, birth injury, epilepsy, congenital hydrocephalus, etc. It is desirable to separate instances of this specific, congenital infection from these heterogeneous groups, since the hope of successful therapy depends upon their recognition. It would seem especially important to detect the inapparent infection of the mother in order to prevent the disease in the child. It is hoped that serological tests and eventually a curative agent will make this possible.

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[14] A. B. Sabin and P. K. Olitsky, SCIENCE, 85: 336, 1937.

EXPERIMENTAL ANTI-PERNICIOUS ANEMIA FACTOR DEFICIENCY IN DOGS

IN the course of studies on intestinal absorption in dogs with "internal" bile fistulae (anastomosis of the gall bladder to the right renal pelvis with ligation of the common bile duct) we have observed the spontaneous development of an anemia. Further careful study has shown the anemia to be of the macrocytic hyperchromic type.

Normal values for red count, hemoglobin, mean corpuscular volume (MCV), mean corpuscular diameter (MCD) and mean corpuscular hemoglobin (MCHb), have been established, as shown in Table 1. The values for dogs kept 6 months or more on our stock diet do not differ significantly from those of animals newly received.

TABLE 1

ERYTHROCYTE CHARACTERISTICS IN NORMAL DOGS

	Number of observations	Number of dogs	Mean	Standard deviation
Red cell count (millions/mm³)	49	25	6.2	0.7
Hemoglobin (grams per 100 ml.)	49	25	12.9	1.8
Mean corpuscular volume (cubic micra)	49	25	71.3	4.4
Mean corpuscular diameter (micra)	19	18	6.7	0.1
Mean corpuscular hemoglobin (micro-micrograms)	49	25	20.9	1.6

Having established the normal blood picture of dogs in this laboratory it also became necessary to set up criteria for an experimentally produced anemia resembling the human macrocytic hyperchromic anemias, such as pernicious anemia and sprue. It is now generally accepted that this type of anemia in man is due to lack of a factor present in liver, which has been termed the anti-pernicious anemia (APA) factor or erythrocyte maturation factor. Such a deficiency is believed to be produced in man either by failure of intestinal absorption (sprue), lack of intrinsic factor in the gastrointestinal tract (pernicious anemia) or by disease of the liver and consequent inability of that organ to store the APA factor produced by reaction between intrinsic and extrinsic factors (macrocytic anemia of human liver disease). No matter in which way the normal chain of events is interrupted, the result is an increase of MCV, MCD and MCHb above

the normal range, a decrease in the red cell count and megaloblastic or erythroblastic hyperplasia of the bone marrow. Human pernicious anemia and sprue respond to the parenteral administration of liver extract, but are not benefited by any substance of known chemical constitution that has been tested. The criteria for an experimental anemia analogous to pernicious anemia and sprue may therefore be given as: (1) Anemia of the macrocytic hyperchromic type; (2) hyperplasia of the erythroblastic tissue of the bone marrow; (3) response to purified liver extract given parenterally; (4) no response to other factors known to be essential in normal nutrition and metabolism.

Fifteen bile fistula dogs have developed anemia with increases in MCV and MCHb. No dog that has survived the operation for 4 months has failed to develop these blood changes. The highest MCV observed is 98.7; 11 of the 15 dogs have shown MCVs above 88.9 (4 S.D. above the mean for normals). The MCV in every dog has remained above 84.5 (3 S.D. above the mean) for considerable periods. Changes in MCHb have not been as striking as those in MCV. They have exceeded 25.7 (3 S.D. above the mean for normal animals) in 8 dogs and have been above 24.1 in the other 7. In 6 animals the MCD has been determined with a filar micrometer during the height of the anemia and has been found to exceed 3 S.D. of the mean for normal animals in each instance, the maximum diameter attained being 7.4 micra.

This anemia usually appears within 2 to 4 months after operation, shows (like pernicious anemia in man) a tendency to spontaneous remissions with reticulocyte showers, and is accompanied (as in sprue) by marked weight loss.

We are indebted to Dr. L. W. Diggs for reports on the condition of the bone marrow, the specimens being obtained by autopsy or biopsy. He informs us that the marrow exhibits a mild erythroblastic hyperplasia, and that the mean diameter of the nucleated red cells decreases following liver therapy.

The response to liver extract (Eli Lilly and Company, purified) given intramuscularly has been studied in 6 animals. In every instance a single injection of 30 units or more has been followed by a reticulocyte increase (2 to 20 per cent.), and a return of MCV and MCHb to within 2 S.D. from the normal mean. Increases of a million or more cells have been produced, but have required frequent injections totaling more than 30 units.

In order to prevent deficiencies that occur when bile is absent from the gastrointestinal tract it has been necessary to inject vitamins A, D, E and K. If these substances are not given parenterally the dogs are likely to succumb when the red cell count falls below 4.0 millions. In addition we have given various animals injections of thiamin, riboflavin, nicotinic acid, pyridoxin, calcium pantothenate and choline without improvement in the blood picture.

Incidental observations are the presence of acid in the gastric secretion, the absence of plasma bilirubin (which in any case is not detectable in the plasma of normal dogs), the presence of normal concentration of plasma protein and a susceptibility to the development of localized infections at the site of subcutaneous injections.

The anemia in the bile fistula dog fulfils the criteria that we have established for an experimentally produced APA factor deficiency analogous to pernicious anemia and sprue. We believe that this deficiency is probably due to a failure of absorption of the APA factor from the intestine. One must consider that the lack of recirculation of bile might interfere with the functions of the liver, and therefore produce a macrocytic anemia that could best be compared to the macrocytic anemia of human liver disease. But this latter condition usually fails to respond to liver therapy and in this respect differs from pernicious anemia, sprue and the anemia of our animals.

It is evident that a readily available experimental macrocytic anemia responsive to liver extract may make available a method of assay for this extract, which must now be standardized on pernicious anemia patients. We hope that continued study of this macrocytic anemia will also help to clarify the etiology of the macrocytic anemias of man.

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DIFFERENTIAL INHIBITION OF PHOTOCHEMICAL AND DARK REACTIONS IN PHOTOSYNTHESIS BY INORGANIC COMPOUNDS

IT has been known for a number of years that certain organic compounds, notably urethanes and cyanides, are capable of inhibiting one or the other of the reactions in photosynthesis. Studies recently completed have shown that various inorganic compounds can likewise inhibit the light and dark reactions separately. Cells of *Chlorella vulgaris* were suspended in test solutions for 20 minutes. They were then rinsed with water and their rates of photosynthesis were determined over a wide range of light intensities by means of Warburg manometers.

The results are shown diagrammatically in Fig. 1, in which the rate of photosynthesis is plotted as a function of light intensity on logarithmic scales. The control or normal curve is used as the basis of com-

parison, and the general types of curves obtained for treated cells are illustrated.

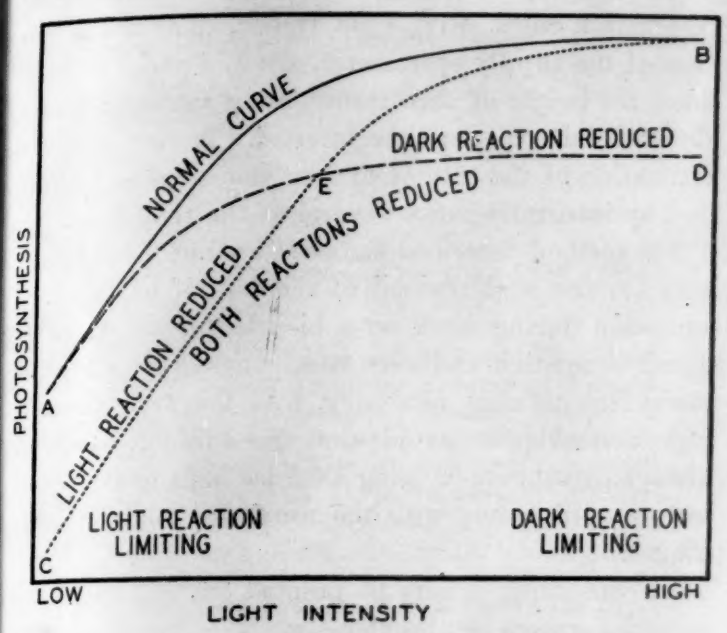

FIG. 1

The curves are interpreted according to the limiting-factor hypothesis of Blackman.[1] Thus, in the normal curve AB, the rate of photosynthesis rises with increase in light intensity over the low intensity range; here light limits or determines the rate of the whole process of photosynthesis. But at higher light intensities the curve flattens, since here light is in excess and some factor controlling the dark reaction limits the rate. In the same sense, at low light intensities the photochemical reaction is limiting and at high light intensities the dark reaction is limiting.

Treatment of cells with $ZnSO_4$, $NiSO_4$ or KCl resulted in a curve of the type AED. These substances retard only the dark reactions of photosynthesis, since their depressing effect is negligible at low light intensities, and is greatest at high light intensities, where the photochemical reaction is in excess and the dark reaction determines the rate of the whole process. In their ability to reduce the dark reaction, these salts resemble hydrocyanic acid[2] and heavy water.[3] It is known that low temperature or deficiency of carbon dioxide gives a similar curve and that cells cultivated in weak light respond in the same manner.

If a substance affected the photochemical reaction alone, greatest inhibition of photosynthesis, as shown by greatest divergence of curves for control and treated cells (as between A and C of curves AB and CEB), would be evident at low light intensity where the photochemical reaction determined the photosynthetic rate, and retardation would become negligible at the highest light intensity. None of the inorganic substances tested gave a curve like CEB, but phenylurethane in Warburg's[2] experiments approximated this type. Chlorophyll deficiency has a similar effect.

Treatment with $CuSO_4$, H_3BO_3, KI, $CoSO_4$ and $(NH_4)_2SO_4$ inhibited photosynthesis over a wide range of light intensities and resulted in curves which were variations of the composite curve CED. It is evident that these substances inhibited both the photochemical and the dark chemical reactions.

Copper sulfate, known to be highly toxic to algae, was found to depress photosynthesis in *Chlorella* exposed for 20 minutes to a 10^{-7} molar solution. In contrast, treatment with 0.4 M $MnSO_4$ had no apparent effect, and *Chlorella* withstood equally high concentrations of KNO_3 and $MgSO_4$. Solutions of higher osmotic pressure, however, depressed photosynthesis and tests with hypertonic sucrose solutions demonstrated that this effect was an inhibition of the dark reaction.

Since inorganic compounds are capable of differential inhibition of the reactions in photosynthesis, their use may provide new evidence regarding the mechanism of the process.

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[1] F. F. Blackman, *Ann. Bot.*, 19: 281–295, 1905.

[2] O. Warburg, *Biochem. Zeitschr.*, 100: 230–270, 1919.

[3] F. N. Craig and S. F. Trelease, *Amer. Jour. Bot.*, 24: 232–242, 1937.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN IMPROVED METHOD FOR THE CONTINUOUS MEASUREMENT OF THE RATE OF OXYGEN CONSUMPTION FOR HUMAN SUBJECTS[1]

THE purpose of the following note is to describe a simple method for the conversion of an ordinary clinical basal metabolism machine to one where continuous measurement of oxygen volume consumption for a subject whether at work or at rest is possible. The accompanying figure shows schematically how this is accomplished. Considering first the apparatus to the left of the dotted line down the middle, one recognizes the usual components of the closed-circuit clinical machine, namely, the mouthpiece (A), triple valve (B), respiration spirometer (C), soda-lime bottle (D) and motor-blower (E). A heat exchanger (F) may be included in the circuit to cool the respiration system. The modification to be described could apply just as well to the clinical machine with soda-lime container and flutter valves inside the spirometer instead of an outside soda-lime bottle and motor-blower.

In our modified apparatus, as the subject metabo-

[1] Contribution No. 32 from the John B. Pierce Laboratory of Hygiene, 290 Congress Avenue, New Haven, Connecticut.

lizes, the carbon dioxide exhaled is absorbed and at the same time the levels of exhalation and inhalation of the spirometer (C) fall. When the level of inspiration falls below a fixed level set by a cam, attached to one of the lips of the pulley-wheel (G), a roller leaf micro-switch[2] (H) is actuated, causing a solenoid valve[3] (I) to open and allowing oxygen to flow from a second spirometer (J) acting as supply into the respiration circuit. A water pressure of 5 to 10 mm in (J) is sufficient to accomplish this. Thus, the oxygen consumed is continuously and automatically replaced during breathing. The supply spirometer (J) may be an old or second-hand (5 liter) clinical machine with flutter valves left in position. The outgoing connection acts as the supply line to the respiration system. At arbitrary fixed time intervals (1, 2, 3 or 6 minutes) a master clock sends an impulse shorting signal closing a double-pole-double-throw relay[4] which, in turn, opens the solenoid valve[5] (K) and refills the spirometer through its in-going connection from a high pressure cylinder (L) with reducing valve (M). The level of refilling is set by a cam on pulley-wheel (N), actuating another roller leaf micro-switch[6] (O), which opens the relay and thus closes the supply valve (K). One sees from the electrical circuit in Figure 1 that valve (I) is always closed when valve (K) is open.

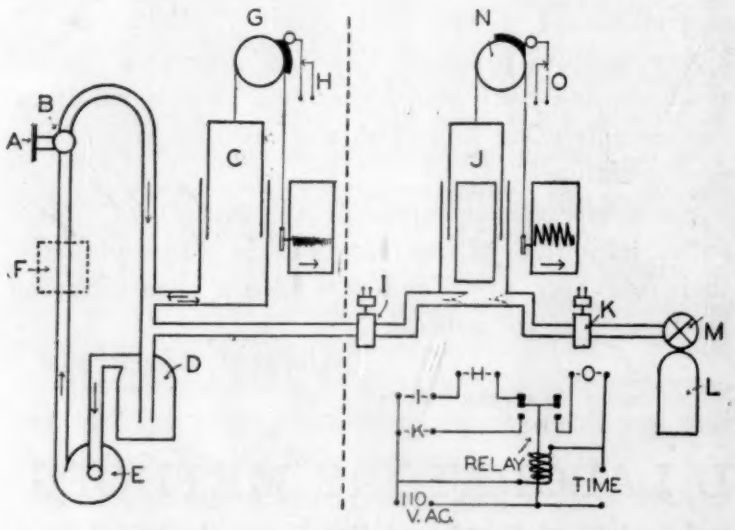

FIG. 1. Apparatus for the continuous measurement of the rate of oxygen consumption.

The motion of the respiration spirometer may describe the type of breathing. The Warren E. Collins, Inc., of Boston, supplies a pulley head for (G) which both integrates the respiration volume and closes a contact for operating an electric counter measuring respiration rates. A second record, that of the motion of the supply spirometer, shows a series of refill lines, the height of each representing the oxygen consumed in the chosen time interval. A very accurate estimation of the rate of oxygen consumption may be had by integrating over several of the refill lines.

The method described has been used at this Laboratory for the measurement of the rate of oxygen consumption during work on a bicycle ergometer. Frequent estimation and even continuous records of this measurement were necessary. At the same time, it was desirable to avoid the space-filling handicap always present when using Douglas bags or large collecting spirometers with the usual gas analysis techniques.

In concluding it may be pointed out that there are several features of the above method that are useful under odd and unusual circumstances:

(a) The apparatus to the left of the dotted line in the figure, being portable, and the size of the usual clinical machine, may be placed compactly and conveniently in the experimental room.

(b) The supply spirometer may be permanently located in another room.

(c) The temperature conditions in these two rooms, provided they are constant relative to each other, may be quite different.

(d) For those interested in metabolism in low pressure chambers, where large volumes of oxygen are used at normal basal rates, the part of the apparatus to the left may be used in the low pressure chamber, while the supply unit giving the record of consumption may remain outside the chamber. For this purpose a needle valve in the supply line would be necessary to adjust the flow from the supply spirometer.

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[2] Manufactured by the Micro-Switch Corp., Freeport, Illinois; Catalogue No. YZ–RL2 (normally open), $1.69 list.

[3] Manufactured by General Controls, New York, N. Y., Type K–3B, 5/16″ port, 110 v. 60 cyc., $6.40 list.

[4] Manufactured by Struthers, Dunn, Inc., Philadelphia, Pa., Catalogue No. CBTX1, 110 v. 60 cyc., $4.25 list.

[5] See Footnote 3. Type K–20, ¼″ port, 110 v. 60 cyc., $6.40 list.

[6] See Footnote 2. Catalogue No. WZ–RL2 (normally closed), $1.69 list.

BOOKS RECEIVED

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